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Mars awash with water

Clues found to ancient hot springs and existing hidden reservoirs

Leah Crane

MARS is full of water, and may once have been home to hot springs. The more we observe the planet, the more we learn about its damp past and largely icy present, both of which could guide human exploration in the future.

We know that billions of years ago, Mars was probably warm enough to maintain liquid water on its surface. By comparing images of strange, oval-shaped, bright areas on Mars with similar-looking terrain on Earth, Dorothy Oehler at the Planetary Science Institute in Arizona and her colleagues have found that ancient Mars may have had hot springs.

These areas have been spotted inside a crater. From their irregular shapes and bright, concentric ellipses, the researchers concluded that they appear to be places where fluid seeped up from underground. These could be prime places to look for evidence of past life. The hot liquid may have been released by the impacts that formed craters, which is how similar-looking hot springs can be made on Earth.

The work was due to be presented at the now cancelled Lunar and Planetary Science Conference (LPSC) in Texas.

"If these were hot springs, looking at them could potentially tell us something about habitable environments," says Jessica Barnes at the University of Arizona. They could have been the best places for life to develop on Mars.

While it isn't clear whether there is still any liquid water beneath Mars's surface, there are water molecules bound up in the chemical structure of its rocks. Barnes and her colleagues used data from Martian meteorites – rocks that chipped off Mars and landed on Earth – to determine where that water came from (*Nature Geoscience*, DOI: 10.1038/s41561-020-0552-y).

They expected to find similar chemical signatures in all of the meteorites, because many models predict that Mars should have been completely covered in a magma ocean shortly after it formed. Such an ocean would have mixed the planet's mantle so that it became homogenous.

But there were some that were different from all the others, which might mean that the magma ocean didn't cover the entire surface. This suggests there may be multiple reservoirs of water locked up beneath Mars.

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Water layer, in micrometres, on Mars if all its vapour condensed

"Different parts of the interior have different signatures," says Barnes. "Maybe these different sources of water are telling us something about the building blocks of Mars."

Another way to learn about the interior of the planet is by examining the ice caps, which are a mixture of frozen water and carbon dioxide. Adrien Broquet at the University of Côte d'Azur in France and his colleagues took a look using radar and elevation data, in work also due to be presented at LPSC.

When a huge ice cap forms on the surface of a planet, it presses down on the ground beneath it. How much the ground sinks depends on the temperature – if the subsurface is cold, it is more rigid and sinks less easily than if it is warm.

"The north polar cap, even though it is really big, it barely deforms the surface at all," says Broquet. This might mean that there are fewer of the radioactive elements that produce heat inside the planet than we thought, he says.

Broquet and his team also found that Mars's north pole seems to contain a surprising amount of frozen carbon dioxide, about 10 times that found at the south pole. That is difficult to account for under current models of the Martian climate.

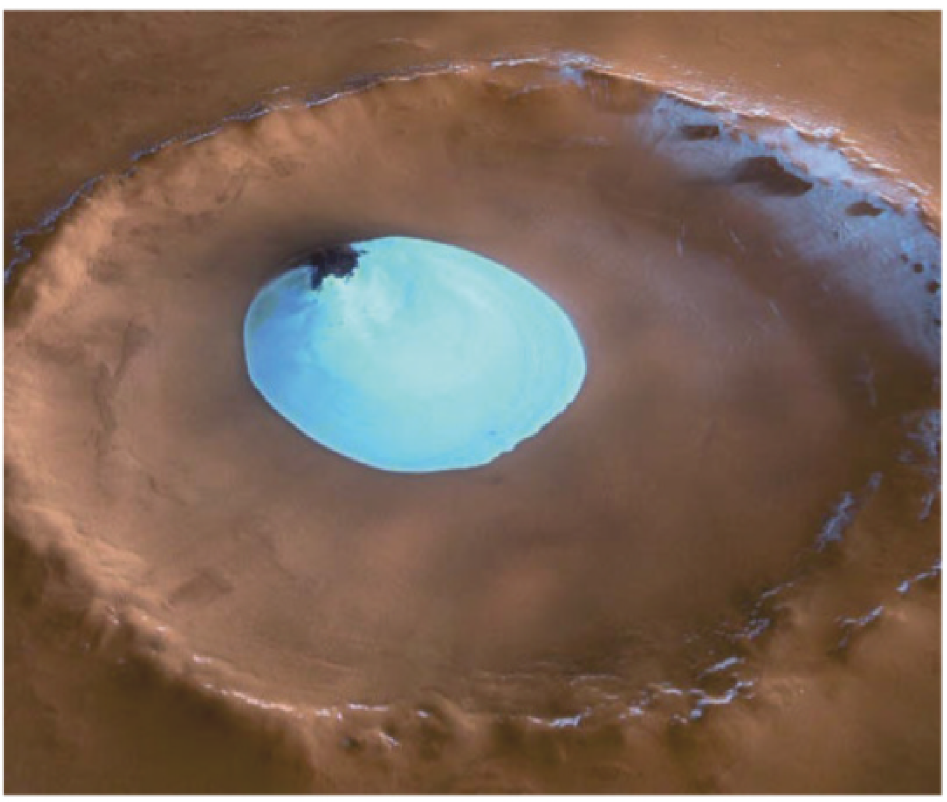
One reason we don't expect to have much carbon dioxide near the north pole is that in the summer it should turn into vapour and then come down as frost in cooler areas.

The same process happens on cool nights with water vapour, both on Earth and on Mars. We have only ever seen Martian frost directly at relatively high latitudes, where the air tends to be colder and more humid. "If we were able to squeeze all the atmospheric water vapour onto the ground and make it liquid, we would form a layer of about 50 micrometres," says Germán Martinez at Los Alamos National Laboratory in New Mexico. That's about 1000 times less water than Earth's atmosphere has.

In their LPSC paper, Martinez and his colleagues used the ChemCam on the Curiosity rover on Mars to look for signatures of extra hydrogen on the ground early in the Martian mornings as a telltale sign of water frost. After three years, they found some, indicating a thin layer.

Continuing to look for such frost could help us understand how much of the water in Mars's atmosphere condenses out onto the surface. All of this research goes towards understanding what kinds of resources are on Mars.

"For future manned missions we need to be able to predict the weather and the climate," says Martinez. "To do that accurately, we need to understand the water cycle on Mars." Understanding this cycle will also be important for any attempts to extract water from the ground, which will be absolutely crucial for future Martian explorers. ∎



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A bright patch of water ice in a crater near the Martian north pole